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December 19, 1996

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Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, DC 20554

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Federal Communications Commission
Office of Secretary

Dear Mr. Caton:

Transmitted herewith for filing with the Commission are an original and ten copies of a report which will serve as Reply Comments in WT Docket No. 96-86.

If there are any questions in connection with the foregoing, please contact the undersigned.

Very truly yours,



Charles L. Jackson

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Federal Communications Commission
Office of Secretary

**BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554**

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| In the Matter of |) | |
| |) | |
| The Development of Operational, |) | |
| Technical, and Spectrum |) | WT Docket No. 96-86 |
| Requirements for Meeting |) | |
| Federal, State and Local Public |) | |
| Safety Agency Communication |) | |
| Requirements Through the |) | |
| Year 2010 |) | |

Reply Comments of Strategic Policy Research

Strategic Policy Research, Inc.
7500 Old Georgetown Road
Bethesda, MD 20814

December 19, 1996

Executive Summary

In the NPRM, the Commission asked for comments on the effect of Project 25 on (1) competition in the highly concentrated market for public safety mobile equipment, (2) spectrum efficiency, and (3) interoperability in public mobile radio.¹ The paragraph raising that question footnoted a 1995 study prepared by Dr. Charles Jackson of Strategic Policy Research, Inc. (SPR).

The SPR study presented compelling evidence that Project 25 limits competition, does not provide significant increases in spectrum efficiency, and does not significantly improve interoperability in public safety radio communications.

A few commentators strongly criticized the SPR study. Those commentators either misinterpreted or misunderstood the SPR study — and that the conclusions of that study stand un rebutted. Further, we show that events occurring since the SPR study was completed support the study's conclusions. In fact, these events demonstrate the SPR study was prophetic.

Project 25 fails to increase spectrum efficiency significantly over current FM systems. It does not provide the spectrum efficiency assumed by PSWAC in their analysis of public safety spectrum needs.

Project 25 raises multiple barriers to competition in public safety radio communications. The most important barriers are the uncertain and restricted rules governing intellectual property rights and the closed interfaces inside Project 25 systems.

There is even the equivalent of a smoking gun on the competitive issue. After the SPR study was prepared, Nokia, one of the major firms mentioned in the SPR study as not entering the U.S. public safety market, stated publicly that they stayed out of this market because of the anticompetitive effects of Project 25 and anticompetitive behavior of the leading vendor in this market. An article in *Land Mobile Radio News*, headlined "Nokia Won't Enter U.S. SMR Market" said:

Because of Motorola's stranglehold on the U.S. public safety market through the recently adopted APCO 25 standard, Nokia has make the decision to stay out of the U.S. private radio market as a whole [emphasis added].

Commentors pointed out that several firms have agreed to supply Project 25 equipment and claimed this as evidence of competition in the Project 25 marketplace. Examining each of these claimed competitors and their activities shows that some are really resellers of Motorola equipment, others are financially floundering, and all are financial midgets compared to

¹ *Notice of Proposed Rulemaking*, WT Docket No. 96-86, paragraph 100.

Motorola. The anticompetitive effects of Project 25 have worked to exclude all the firms in the world that produce a million radios a year.

The conclusions regarding Project 25 limitations set forth in the 1995 SPR study, *A Need to be Heard: Will Project 25 Meet Public Safety Communications Needs in 1995 and Beyond?*, are still valid. Furthermore, the comments of the APCO Project 25 Steering Committee, including the reports by Transcript and Motorola, do not provide any valid basis for disputing the conclusions of the 1995 SPR study when they were made or today.

These identified shortcomings in the Project 25 standard appear to grow from two roots. First, the Project 25 process did not take sufficient account of the problem of control of IPRs by the public safety land mobile radio market's dominant supplier. Second, the Project 25 design was not optimized for spectrum efficiency in urban areas. The channel-splitting approach used by Project 25 generates spectrum efficiency gains very slowly if at all. Any spectrum efficiency gains will come only after a large fraction of users convert to similar narrowband technologies. Further, the ultimate efficiency of Project 25, Phase 1, 12.5 kHz per active conversation, is well below today's state-of-the-art. TETRA, a TDMA system designed for public safety applications, packs four voice channels into 25 kHz and is an irrefutable proof that it is possible today to build a system providing immediate spectrum gains twice what Project 25, Phase 1 can provide in the most favorable long run and four times what Project 25 can provide in this century. Furthermore it is clearly arguable that Project 25, Phase 2, something that will not come for years to come, with 6.25 kHz channels as now envisioned in refarming will never actually provide efficiency as good as TETRA-like systems can provide today.

In its NPRM, the Commission asked for comments on whether Project 25 will further restrict competition in a market already concentrated, not contribute to spectrum efficiency, and not move public safety closer to interoperability.² These comments offer abundant answers to each of these questions. Project 25 will restrict competition — indeed by excluding Nokia has already reduced competition. Project 25 appears highly unlikely to contribute to spectrum efficiency in the short run. Project 25, Phase 1 lacks the efficiency needed in the long run. Project 25 will not appreciably aid interoperability — the major problems of interoperability are not addressed by Project 25.

² NPRM, paragraph 100.

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I. Introduction

In its Notice of Proposed Rulemaking in WT Docket 96-86, the Commission asked for comments on the effect of Project 25 on (1) competition in the highly concentrated market for public safety mobile equipment, (2) spectrum efficiency, and (3) interoperability in public mobile radio.¹ The paragraph raising that question footnoted a 1995 study, *A Need to Be Heard: Will Project 25 Meet Public Safety Communications Needs in 1995 and Beyond?* [hereinafter SPR study] prepared by Dr. Charles Jackson of Strategic Policy Research, Inc. (SPR).

SPR believes that the SPR study presented compelling evidence that Project 25 limits competition, does not provide significant increases in spectrum efficiency, and does not significantly improve interoperability in public safety radio communications.

A few commentors, most notably the Association of Public-Safety Communications Officials-International, Inc. (APCO) Project 25 Steering Committee, strongly criticized the SPR study. These reply comments show that those commentors either misinterpreted or misunderstood the SPR study — and that the conclusions of that study stand un rebutted. Further, we show that events occurring since the SPR study was completed support the study's conclusions. In fact, these events demonstrate the SPR study was prophetic.

¹ Notice of Proposed Rulemaking, WT Docket No. 96-86, paragraph 100.

For background, SPR is a consulting firm located in Bethesda, Maryland, providing a variety of regulatory and business services to clients — predominantly from the telecommunications industries. SPR's clients include Ericsson, a manufacturer of land mobile radio equipment and sponsor of the 1995 report. Ericsson's sponsorship of the SPR study was clearly disclosed in the study.

These reply comments are those of SPR and do not necessarily reflect the position of any SPR client.

II. No Compelling Rebuttal of the Main Points of "*A Need to Be Heard*"

The primary critical commentator on the SPR study was the APCO Project 25 Steering Committee as distinguished from APCO itself.² However, it must be noted that APCO's own comments stated that they fully supported the conclusions of the Steering Committee on this matter.³

The Steering Committee discusses the SPR study on pages 13 through 19 of their comments and they attach two studies critical of the SPR study to their comments. The Steering Committee's comments are somewhat confusing because they combine analysis of a second, separate report

² Comments of the APCO Project 25 Steering Committee, Docket WT 96-86, October 21, 1996.

³ Comments of Association of Public-Safety Communications Officials-International, Inc. (APCO) in WT Docket 96-86, October 21, 1996, p. 29.

discussing recent experiences in public safety procurement with the SPR study and refer to both as the Jackson report.

The two attached studies to the Steering Committee comments included one sponsored by Transcript, a small manufacturer of voice privacy equipment that has announced that it will provide Project 25 portable units, and another prepared by Motorola. The Transcript study was authored by George Kameron and is dated July 1996.⁴ The Motorola study is dated 1996.

Our reply comments proceed in three steps. First, we review the major claims concerning Project 25 that were made in the original SPR study. Then, for each point, we restate the point, summarize the major criticisms made in the Steering Committee comments, the Transcript report, and the Motorola study. Finally, we review the original argument and events occurring since July 1995 to see if the position put forward in the original SPR study appears correct in light of all the evidence.

III. A Review of the 1995 SPR Study

The 1995 SPR study reviewed the background of Project 25, from its inception in 1989 to its then-current status. The study offered four major criticisms of Project 25:

⁴ The Transcript report goes beyond the bounds of the usual discourse in FCC pleadings. It specifically accuses the SPR study of being intentionally dishonest (Transcript, p. 7). We strongly dispute this accusation. There are no statements in either the original SPR study or this reply comment that we knew then or know today to be false. The Transcript report author confuses statements he dislikes and that make him squirm with statements that are dishonest.

- Project 25 was behind schedule and incomplete;
- The Project 25 design has a closed A interface;
- Problems with intellectual property rights limit competition; and
- Project 25 fails to achieve either its promised spectrum efficiency or the spectrum efficiency needed in public safety mobile radio.

The report also made a lesser criticism of Project 25 — that its FDMA architecture prevented the agency that invested in “spectrum efficient technology” from realizing those efficiency gains.

The following sub-sections discuss each of these points in greater detail.

A. Project 25 Schedule

The 1995 SPR study observed that Project 25 was falling far behind its original schedule. The study quoted APCO leadership in 1990 stating that the new technologies could be implemented in 24 to 36 months.⁵ In other words, the original claims were that Project 25 systems would be operational in 1992 or 1993.

The closest the Steering Committee came to responding to the delay problem was their statement that “debate on Phase I is no longer appropriate or productive.”

⁵ SPR study, p. 10.

The Transcript report fails to discuss the delay problem at all, except perhaps when it states that "Project 25 meets its published goals" and "in fact, Project 25 will exceed its goals."⁶

Motorola appears to believe that the delay in the Project 25 process is not a problem. Motorola states, "From a manufacturers [sic] perspective APCO Project 25 has progressed more rapidly than standards not directly influenced by users." And Motorola also says, "Motorola does not believe that the careful consideration and standard development has been slow or tardy in any aspect."

Seven years is a long time — and is certainly a lot longer than APCO originally claimed would be needed. Yet, even today, the Project 25, Phase 1 specification is not complete. Work is still underway on the network management interface and the intersystem interface. We can compare Project 25 progress with that of other standards.

In early spring 1993, the Special Panel convened by the Advisory Committee on Advanced Television Service (ACATS) recommended that consideration of work on analog-advanced television end and that only digital ATV be pursued further. After that the Grand Alliance was formed, and, about two and a half years after the Special Panel meeting, a completed ATV standard (reflecting implementation and testing) was adopted by the Advanced Television

⁶ Transcript report, p. 15.

Systems Committee (ATSC) in the fall of 1995 and was recommended to the FCC by the ACATS.

About the same time as the Special Panel was meeting, a European DTV effort got underway. The Digital Video Broadcasting (DVB) Memorandum of Understanding was signed in 1993 and an effort got underway to define a family of digital video standards for cable, satellite, and terrestrial broadcasting. The DVB is a complex organization with over 170 members from 21 countries. The first two DVB standards were adopted by the European Telecommunications Standards Institute (ETSI) in January 1995 and DVB equipment was being sold in 1995. Currently several satellite systems are providing service using the DVB standards — including two systems operating in the U.S. today.⁷

TETRA, a digital land mobile standard, appears to have started more slowly than the DVB standard but moved quickly once the standards process got fully underway. In 1990, ETSI established a group to consider standards for digital mobile radio. The TETRA Memorandum of Understanding was signed in December 1994. In late 1995, a vote at ETSI established standards for General Network Design, the Air Interface, and Radio Conformance Testing. Motorola ran an alpha-test of TETRA equipment in 1996 with the States of Jersey and launched their commercial product in November 1996.

⁷ See <http://www.alphastar-tv.com/dvb> for information on the development of the DVB standard.

Project 25 has taken far longer than its supporters claimed it would and longer than other, roughly comparable, standards efforts. The conclusions on delay in the SPR study were and still are correct.

The delay in Project 25 has had multiple negative consequences. Most importantly, technological choices made for Project 25 that arguably may have been appropriate for 1990 do not necessarily reflect current technological capabilities. Project 25 may well represent reasonable spectrum efficiency for public safety land mobile in 1991 — but it certainly does not represent reasonable spectrum efficiency for the present.

B. Closed A Interface

The 1995 SPR study observed that the interface between the equipment at the control point or console location and the radio equipment at the base stations was not an open interface. The study observed that a closed interface here strongly limits competition. It prevents firms that only supply base stations from entering the market. It restricts customers to buying upgrades only from the manufacturer of their original system. The 1995 SPR study compared this closed element of the Project 25 specification with the efforts in the cellular industry to create an open A Interface.

The Project 25 Steering Committee did not directly address this point.

The Transcript report does address this issue. Reviewing the interfaces in the Project 25 specification, it concludes that, "Project 25 has the appropriate interfaces necessary to serve the Public Safety users. These interfaces are open to any supplier."⁸ The Transcript report also makes the point that Phase 2 of the Project 25 process will define a console interface, but distinguishes the console interface from the A interface discussed by SPR.⁹

In contrast, Motorola does not distinguish between the console interface and the A interface, rather they identify them as did the SPR study. Motorola makes three points regarding this interface:

- An open A interface offers little opportunity for savings;
- Phase 2 will standardize this interface; and
- "This interface, contrary to Dr. Jackson's assertion, has not been deployed in today's fielded cellular systems."¹⁰

Project 25's recognition, apparently after the SPR study was published, that this interface should be open is a step in the right direction. But, Project 25's decision to do in the future what the SPR study said that they should have done earlier, is hardly a compelling criticism of the SPR study. The lack of an open A interface is a clear indication that the Project 25 undertaking

⁸ Transcript report, p. 11.

⁹ Transcript report, pp. 7, 11.

¹⁰ Motorola report, pp. 7-8.

contained major and fatal flaws at the beginning. They did not look at the critical issues involved with promoting interoperability among products from multiple vendors or search for ways to break down the current barriers to entry in the market.

Motorola's claim that openness of the A interface is an unimportant issue, since base stations are cheaper than their associated portable radios, ignores two important issues. First, without competition for upgrades, the price of base stations is not market driven, it is whatever the provider of base stations believes will maximize profits — in a monopoly environment.¹¹ Second, an open A interface would allow firms specializing in either consoles or base stations to enter the market. A closed A interface means that a firm must be able to provide both system elements to be a player in the market.

Motorola's claim that an open A interface has not been deployed in the cellular field as Jackson said is doubly false. First, an examination of the SPR study will show that Dr. Jackson did not quite make that claim. Rather, he made the lesser claim that cellular service providers wanted to be able to mix and match cell radios and that manufacturers were building equipment with an open A interface at the time the report was prepared. He cited specific manufacturer's claims for

¹¹ In economists' jargon, this view is that, because base stations and their complements (portables) are consumed in roughly fixed proportion, possessing a monopoly on just one of the two products while the other is sold competitively can be just as lucrative as possessing a monopoly on both products.

such capability. He did not state that the cellular industry had deployed such equipment.¹²

However, we have been reliably informed that numerous cellular systems, mostly GSM systems, have been deployed using switches from one vendor and base stations from another. Documents on the Motorola web server confirm this information.¹³

C. Intellectual Property Rights Problems

The SPR study stated that intellectual property rights (IPRs) posed a contentious issue in the Project 25 debate. The SPR study raised two IPRs concerns:

- Will Motorola license all patents needed to provide a realistically competitive Project 25 product?

¹² See SPR study, p. 14.

¹³ A quick visit to the Motorola web server (<http://www.mot.com/General/gss.html>) will lead to several documents indicating the open A interface is operational. Here is one quote (CIG refers to Motorola's Cellular Infrastructure Group):

CIG is a strong proponent of open system architectures for the wireless industry. CIG's base stations work with a variety of world class landline and mobile switches, including its own EMX 2500. Motorola has established relationships with nine major switch manufacturers to provide equipment on a variety of network interfaces, including V5.2 for wireless local loop, A for GSM, and A+ for North American wireless applications.

At <http://www.businesswire.com/emk/motcig95/motcig01221.htm>, we find a December 1995 Motorola press release which says:

Motorola has supported open interfaces for several wireless technologies, including GSM (Global System for Mobile Communications) architecture and the 'A interface' between cellular switches and cellular radio infrastructure in Europe; in Japan, the 'PDC (Personal Digital Cellular) A+' interface; in North America, the TIA (Telecommunications Industry Association) 'A+' standard (IS-634) and globally, the V5.2 interface for trunked connections to wireline switches.

- Will Motorola impose market restrictions on the use of Project 25 patents that limit a licensee's ability to compete?

The Steering Committee does not directly address the concerns raised over IPRs in the SPR study. They do offer a general statement on IPRs which deserves to be considered in its entirety.

They said:

The Project 25 Steering Committee also finds Ericsson expressed concerns about the encumbrance of Intellectual Property Rights (IPRs) inconsistent with their often-stated claim that they want more competition in the marketplace. Any company that wants to build new technology products must deal with the reality of IPRs. Ericsson knows if they want to use someone's IPR, they are ethically obligated to obtain a licensing agreement. Certainly the process of negotiating license agreements can and sometimes does become contentious. However, neither the Commission nor the public safety community should be intimidated by the specter of the manufacturing community having to work in good faith efforts to resolve IPR issues.¹⁴

Fair enough. SPR believes that protection of intellectual property is important and that owners of intellectual property have a right to bargain for its use in the market. Note, however, that the foregoing Steering Committee statement does not say that the Project 25 process assures manufacturers fair and equal access to the necessary IPRs. Rather, the Steering Committee states that the rights to use of IPRs are left to negotiations among the parties. But, leaving the rights-to-use of IPRs subject to negotiation between the parties is the heart of the SPR criticism of Project 25's IPR policies. If Motorola has a choice between (1) restricting its IPRs and thereby gaining monopoly profits on Project 25 equipment, and (2) widely licensing its IPRs and

¹⁴ Steering Committee Comments, p. 9.

increasing competition, one does not have to be an expert economist to predict the outcome.

Project 25 lacked and still lacks an agreement requiring open and non-discriminatory licensing of all IPRs needed to build a Project 25 radio without delay or favoritism.

Transcript responds to this issue by stating that, "The important part of the Project 25 Standard is that, by definition, the proprietary technology **essential for implementation of the standard** are available with license terms free of discrimination."¹⁵ Motorola makes a similar point regarding **essential** IPRs.

A key point made in the SPR study is the limitations imposed by the phrase *essential technology* in the Project 25 context. If Motorola is to be the judge of which patents are essential to Project 25 and which are merely nice, then, given Motorola's patent portfolio in respect to the Project 25 technologies, Motorola will be able to determine whether a firm will be a success or a failure in the Project 25 market. From the point of view of a possible entrant to the Project 25 market, the uncertain nature of Motorola's licensing policies creates a barrier to entry. How does a firm know if it can produce a truly competitive product meeting Project 25 user needs if the licensing policy is uncertain or unclear? As we discuss below, the trade press reports that Nokia, one of the world's largest mobile equipment manufacturers, chose not to enter the U.S. market because of the limitations created by Project 25.

¹⁵ Transcript report, p. 11, emphasis in original.

D. Spectrum Efficiency Failings

The SPR study strongly criticized the lack of spectrum efficiency of the Project 25 design.

The Steering Committee disputes the findings on spectrum efficiency and offers the view that spectrum efficiency is really a “red herring designed to divert attention.”¹⁶ If spectrum efficiency is a “red herring” then it has led many people down the wrong path.¹⁷ The 1995 SPR study chose spectrum efficiency as an objective for analysis because, “In 1990, APCO set forth three fundamental goals for Project 25: Obtain maximum spectrum efficiency, ensure competition in system life procurements, and allow effective and reliable interagency communications.”¹⁸ It was the APCO Project 25 Steering Committee that set spectrum efficiency as the first stated Project 25 objective. All the SPR study did was ask (and answer) the question: Did Project 25 achieve its announced goals for spectrum efficiency? If there is a red herring about the premises, the Steering Committee is the fisherman!

Transcript disputes the conclusions on spectrum efficiency and states that “instantaneous implementation of a Project 25 system will immediately deliver significant increases in spectrum use if the required funds are available.” Transcript also criticizes the analysis in the SPR study

¹⁶ Steering Committee, pp. 16-19, “red herring,” p. 19.

¹⁷ We note that the Commission asks questions regarding spectrum efficiency in at least paragraphs 80, 81, 100, and 101. In paragraph 98 of the NPRM, the Commission lists increased spectrum efficiency as an objective of Project 25.

¹⁸ SPR study, p. 4, citing APCO *Statement of Requirements*, 1990.

which observed that FDMA technologies return spectrum to a common pool while TDMA allows the entity upgrading their radio system to gain the benefits of the improved productivity.

Motorola offers a somewhat similar criticism of the SPR study and offers its own spectrum efficiency metrics. Motorola puts forward as spectrum efficiency measure the modulation efficiency of a radio measured in bits/sec/Hz. Motorola tabulates such efficiency measures for APCO Project 25, a proposed Ericsson product, and the TETRA standard.

The near-term spectrum efficiency generated by a Project 25 radio is limited by how the system is used relative to other nearby adjacent and cochannel spectrum users. Project 25, Phase 1 systems, when used with the channel plan given by the FCC's refarming order, will not free up units of 12.5 kHz that can be reused, reassigned or reallocated, due to the fact that there is no shift in channel center frequencies under the refarming rules. Consequently, there is no near-term gain in spectrum efficiency. Figure 1, below, is taken from the FCC's refarming order and shows how channels are being refarmed.

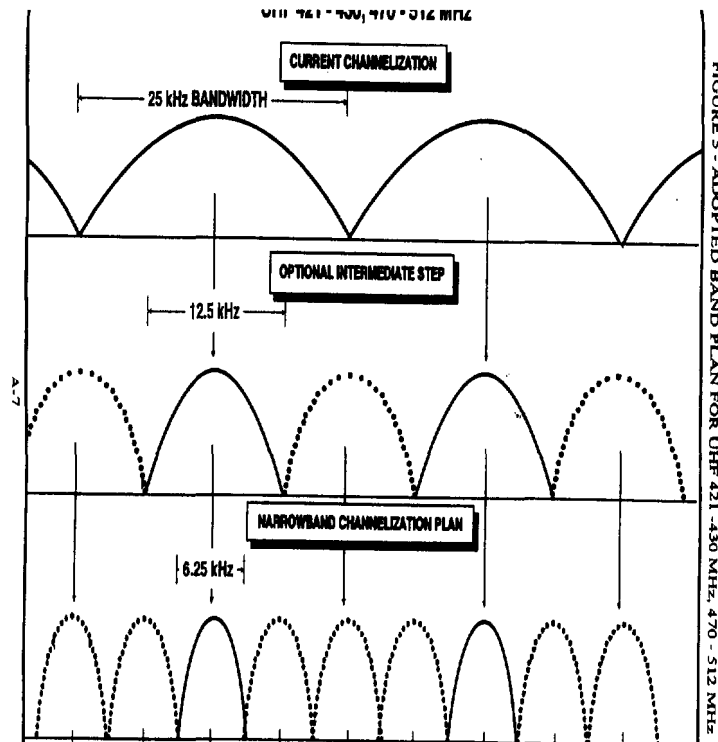


Figure 1

As an illustration of the foregoing, consider users (A, B, and C) operating on *adjacent* channels in the same geographical area. Assume that user B installs a Project 25 radio system. User B must still continue to operate on the same frequency. The new narrowband signal frees up 6.25 kHz of spectrum at the edges of B's channel. Not until user B's neighbors spend the money for a narrowband system can a new channel be dropped in. Adoption of Project 25 will free up 6.25 kHz slivers — not usable 12.5 kHz channels. This process is illustrated in Figure 2, below. Only in the long-run, after widespread adoption of Project 25, will it be possible to gain additional channels. In the short-run, the day after user B spends his money, no one gets any additional spectrum.

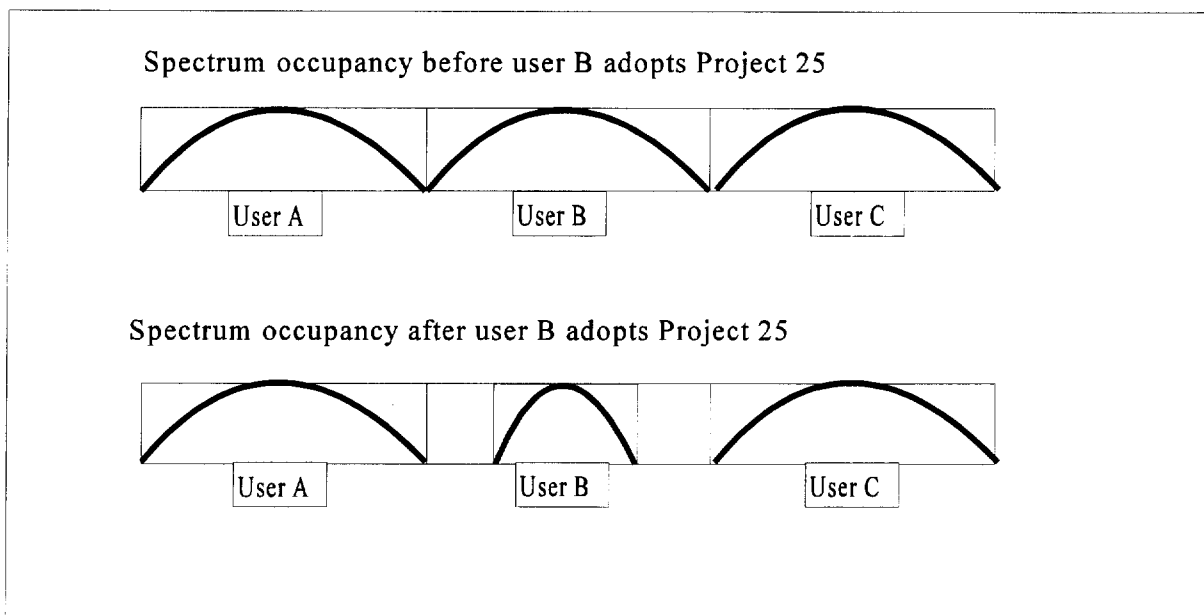


Figure 2

Neither the APCO Project 25 Steering Committee, Transcript, nor Motorola admitted — let alone responded — to this fundamental fact regarding Project 25, Phase 1.

Motorola's claims on spectrum efficiency deserve some further consideration. They suggest that a reasonable measure of spectrum efficiency is the raw channel bit rate (bps/Hz) and they present such a measure for several communications system designs.¹⁹ Indeed there is some merit in this measure. Their table shows Project 25, Phase 1 with an efficiency measure of 0.768 bps/Hz, TETRA with an efficiency measure of 1.44 bps/Hz and Project 25, Phase 2 with an efficiency measure of 1.536 bps/Hz.

¹⁹ Motorola report, p. 6.

There are at least three errors in the Motorola table. First, they ignore the effects of the channel plan problem described above. If a Project 25 radio is operating in a 25-kHz channel, filling 12.5 kHz of that channel and leaving empty 6.25-kHz regions on either side, the proper measure of its modulation efficiency is really only half that shown in the Motorola table.

Second, Motorola purports to show the spectrum efficiency for APCO Project 25, Phase 2 as 1.536 bps/Hz. Yet, in their comments the Project 25 Steering Committee says, "As of this date, **there have been no decisions made on the technologies that would best fit the needs of the user in Phase II**, our 6.25 KHz standards effort."²⁰ Given that the Steering Committee is the official decision-making body regarding Project 25, the Motorola table entry for Phase 2 should be disregarded.²¹

Third, raw modulation efficiency is a weak measure of spectrum efficiency. Communications effectiveness depends upon speech quality which is a function of modulation, error correction coding, and vocoder quality. Simply comparing the raw bit rate of two systems that each achieve one voice signal in a 6.25-kHz equivalent channel width can easily mislead. A different

²⁰ Steering Committee Comments, p. 17, emphasis added.

²¹ One of the persistent criticisms of Project 25 is that it has been dominated by Motorola and reflects an uncritical adoption of Motorola technologies. To the extent that this is true, then Motorola may well know what the Project 25, Phase 2 technology will be before the Steering Committee does. If, in fact, Motorola has already chosen the Phase 2 modulation technology, then our critique above of the Motorola report's use of Phase 2 modulation efficiency is incorrect. The juxtaposition of the Steering Committee statement with Motorola's claim of knowledge of the Project 25, Phase 2 design parameters is nevertheless thought provoking.

Motorola document makes the case well that other system attributes can control overall efficiency when it states:

The benefits of TETRA compared with GSM and Frequency Division Multiple Access (FDMA) systems is that it is more flexible for transferring non-voice information. For example, TETRA is designed to allow simultaneous transmission and reception of voice and data over one radio unit. The benefits for dispatching Fire Crews and A&E Ambulance crews with this capability are obvious.

In addition, TETRA has the capability of utilizing all four (4) Time Division Multiple Access (TDMA) time slots for transferring non-voice information with usable data rates of up to 28.8 Kbps. The use of higher data rates will transfer non-voice information more efficiently and quickly.

TETRA is currently four times more spectrum efficient than GSM and twice as efficient when the half rate codec is implemented. **TETRA is also twice as efficient than current 12.5 kHz channel spaced FDMA systems.**²²

Even though the Motorola study is put forward to rebut the SPR study, the table in the Motorola study supports the conclusion that TDMA designs in the market today (such as TETRA) beat Project 25, Phase 1 using the spectrum efficiency measure advocated by Motorola.²³ There is substantial reason to believe that such equipment will match and surpass the efficiency of Project 25, Phase 2, whenever the Steering Committee chooses a Phase 2 design.

²² Motorola RNSG, TETRA Questions and Answers, undated, but probably November 1996, p. 8, emphasis added.

²³ Some readers may question whether system designs providing four voice channels in 25 kHz for public safety applications are yet being marketed. Attachment A is a compendium of news stories and promotional materials describing Motorola's TETRA product and their market introduction of that product in London, on November 12, 1996.

The PSWAC final report also puts Project 25 efficiency in perspective.²⁴ The PSWAC Spectrum Requirements Subcommittee estimated that “the average Public Safety voice radio system in use in the year 2010 would require only 4 kHz of spectrum per active conversation.”²⁵ PSWAC went on to observe: “To put this requirement into perspective, assuming that the older one fourth of installed equipment in 2010 operates with a spectrum efficiency of 12.5 kHz per active conversation (the level required for new type acceptances today under the FCC’s Refarming Rules, but not yet in significant use in Public Safety), if the SRSC’s forecasts are to be met, the other three-quarters of equipment must operate with a spectrum efficiency of 1.17 kHz per active conversation.”²⁶

According to the PSWAC analysis, the average public safety radio 13 years from now will be far more spectrum efficient than a Project 25 radio, and Project 25 radios can comprise only a small minority of all systems operating in 2010 if there is to be sufficient spectrum for others. Given that public safety radio systems last for 15 to 20 years, it is clear that the PSWAC analysis and recommendations are not compatible with any significant use of Project 25, Phase 1 radios at any time. Project 25 does not deliver the spectrum efficiency required to match the PSWAC

²⁴ In our discussion, we focus on the PSWAC analysis of voice communications. The technological assumptions used by PSWAC in considering non-voice communications, in particular the high level of modulation efficiency assumed, were even more demanding than were used for voice communications. Hence, our conclusions apply with even more strength to non-voice applications.

²⁵ PSWAC Final Report, p. 56, footnote omitted.

²⁶ PSWAC Final Report, p. 57.

analysis. Yet, if public safety does not meet the efficiency assumed in the PSWAC analysis, then the additional spectrum requested by PSWAC will not be sufficient to meet public safety needs. One cannot consistently hold both views (1) that PSWAC report is well done and represents sound analysis, and (2) that there will ever be substantial use of Project 25, Phase 1 radios.

In contrast, TETRA, with its four voice channels in 25 kHz and its bandwidth on demand features, comes closer to matching the PSWAC assumptions.

Upon examining the refarming rules, the PSWAC Final Report, and the other equipment in the marketplace, we believe that the conclusive criticisms of Project 25 spectrum efficiency made in the 1995 SPR study are still justified and unchallenged by the commentators.

IV. Other Observations

The commentators on the SPR study also took exception to some minor points in the SPR study. We respond to a few of those comments below.

A. Attracting Competitive Entry

The SPR study faulted Project 25 for not developing a standard that attracted new major competitors into the public safety land mobile market. There are a number of major electronic manufacturers who have the technological capability to produce equipment for the public safety market who do not participate in that market. A truly open standard would create an opportunity for such firms to enter and serve market needs.